ECT352	DIGITAL IMAGE PROCESSING	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: This course aims to develop the skills for methods of various transformation and analysis of image enhancement, image reconstruction, image compression, image segmentation and image representation.

Prerequisite: ECT 303 Digital Signal Processing

Course Outcomes: After the completion of the course the student will be able to

CO 1	Distinguish / Analyse the various concepts and mathematical transforms necessary for image processing
CO 2	Differentiate and interpret the various image enhancement techniques
CO 3	Illustrate image segmentation algorithm
CO 4	Understand the basic image compression techniques

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	2		1							2
CO 2	3	3	2		1							2
CO 3	3	3	3		1							2
CO 4	3	3	3		1							2

Assessment Pattern

Bloom's Category		Continuous Assessment Tests		End Semester Examination
		1	2	
Remember	K1	10	10	10
Understand	K2	20	20	20
Apply	K3	20	20	70
Analyse	K4			
Evaluate				
Create				

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:
Attendance: 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks. The questions must have 50% representation from theory, and 50% representation from logical/numerical/derivation/ proof.

Course Level Assessment Questions

Course Outcome 1 (CO1): Analyze the various concepts and restoration techniques for image processing

1. For the given image check whether pixel P and Q have 8 connectivity.
2. Find filtered image using median filter.
3. Explain Weiner filtering.

Course Outcome 2 (CO2): Differentiate and interpret the various image enhancement techniques

1. Classify different image enhancement process. Differentiate between spatial domain and frequency domain techniques of image enhancement.
2. What is histogram equalisation? Briefly discuss the underlying logic behind histogram equalisation.
3. Apply mean and median filters over a given image.

Course Outcome 3 (CO3): Illustrate image segmentation algorithm

1. Name two basic approaches of image segmentation and mention their differences.
2. How can you decide optimal thresholds when the image contains a background and several foreground objects? Write down a corresponding algorithm.
3. Write down the region growing algorithm. What are its advantages and disadvantages?

Course Outcome 4 (CO4): Analyze basic image compression techniques

1. What do you mean by compression ratio? Do you consider that lower compression ratio ensures better images upon reproduction?
2. How can achievable compression ratio to be determined from image histogram?
3. Mention the steps of lossy and lossless JPEG compression

SYLLABUS

Module 1

Digital Image Fundamentals: Image representation, basic relationship between pixels, elements of DIP system, elements of visual perception-simple image formation model. Vidicon and Digital Camera working principles Brightness, contrast, hue, saturation, mach band effect
Colour image fundamentals-RGB, CMY, HIS models, 2D sampling, quantization.

Module 2
Review of matrix theory: row and column ordering- Toeplitz, Circulant and block matrix
2D Image transforms: DFT, its properties, Walsh transform, Hadamard transform, Haar transform, DCT, KL transform and Singular Value Decomposition.
Image Compression: Need for compression, Basics of lossless compression – bit plane coding, run length encoding and predictive coding, Basics of lossy compression – uniform and non-uniform quantization techniques used in image compression, Concept of transform coding, JPEG Image compression standard.

Module 3
Image Enhancement: Spatial domain methods: point processing- intensity transformations, histogram processing, image subtraction, image averaging. Spatial filtering- smoothing filters, sharpening filters.
Frequency domain methods: low pass filtering, high pass filtering, homomorphic filter

Module 4
Image Restoration: Degradation model, Unconstraint restoration- Lagrange multiplier and constraint restoration
Inverse filtering- removal of blur caused by uniform linear motion, Weiner filtering,
Geometric transformations-spatial transformations

Module 5
Image segmentation: Classification of Image segmentation techniques, region approach, clustering techniques. Segmentation based on thresholding, edge based segmentation. Classification of edges, edge detection, Hough transform, active contour.

Text Books
1. Gonzalez Rafel C, Digital Image Processing, Pearson Education, 2009
2. S Jayaraman, S Esakkirajan, T Veerakumar, Digital image processing, Tata Mc Graw Hill, 2015

Reference Books

1. Jain Anil K , Fundamentals of digital image processing: , PHI,1988
2. Kenneth R Castleman , Digital image processing:, Pearson Education,2/e,2003
3. Pratt William K , Digital Image Processing: , John Wiley,4/e,2007

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**Digital Image Fundamentals**	
1.1	Image representation, basic relationship between pixels, elements of DIP system, elements of visual perception-simple image formation model	3
1.2	Vidicon and Digital Camera working principles	1
1.3	Brightness, contrast, hue, saturation, mach band effect	1
1.4	**Colour image fundamentals**-RGB, CMY, HIS models	1
1.5	2D sampling, quantization.	1
2	**Review of matrix theory**	
2.1	Row and column ordering- Toeplitz, Circulant and block matrix	2
2.2	**2D Image transforms** : DFT, its properties, Walsh transform, Hadamard transform, Haar transform	3
2.3	DCT, KL transform and Singular Value Decomposition.	3
2.4	**Image Compression:** Need for compression, Basics of lossless compression – bit plane coding, run length encoding and predictive coding, Basics of lossy compression – uniform and non-uniform quantization techniques used in image compression, Concept of transform coding, JPEG Image compression standard..	2
3	**Image Enhancement**	
3.1	Spatial domain methods: point processing- intensity transformations, histogram processing, image subtraction, image averaging	2
3.2	Spatial filtering- smoothing filters, sharpening filters	1
3.3	Frequency domain methods: low pass filtering, high pass filtering, homomorphic filter.	2
4	**Image Restoration**	
4.1	Degradation model, Unconstraint restoration- Lagrange multiplier and constraint restoration	2
4.2	Inverse filtering- removal of blur caused by uniform linear motion, Weiner filtering	2
4.3	Geometric transformations-spatial transformations	2
5	**Image segmentation**	
5.1	Classification of Image segmentation techniques, region approach, clustering techniques	2
5.2	Segmentation based on Thresholding, edge based segmentation	2
5.3	Classification of edges, edge detection, Hough transform, active contour	3

Simulation Assignments

The following simulations be done in Scilab/ Matlab/ LabView:

1. Read Image data into the workspace.
2. Determine various transforms using matlab functions.
3. Detect and measure circular objects in an image.
4. Adjust the contrast of the given image.
5. Filter images using predefined filter.
6. Create degraded images affected by motion blur and noise by simulating the models for both. Apply inverse filtering and Weiner filtering methods to the simulated images and compare their performance.
7. Detect an object against the background using various edge detection algorithms and compare their performance.
8. Create a histogram for a gray scale image.
9. Create image at various compression level.
10. Use texture segmentation to identify region based on their texture.

Model Question paper

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, (**Model Question Paper)**

Course Code: ECT352

Course Name: DIGITAL IMAGE PROCESSING

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

1. Give mathematical representation of digital images? Write down the names of different formats used. K2
2. Explain mach band effect. K2
3. What is SVD? Explain its applications in digital image processing. K3
4. Write the similarity and difference between Hadamard and Walsh transforms K3
5. What are the advantages and disadvantages of block processing K2
6. Name the role of point operators in image enhancement K2
7. What is median filter? Explain the operation in 2D noise image with salt and pepper noise K3
8. Distinguish between linear and nonlinear image restoration. K3
9. Mention the use of derivative operation in edge detection. K4
10. The Pewitt edge operator is much better than Robert operator. Why? Give the matrix. K3

PART B

Answer any one full questions, from each module carries14marks.

Module 1

1. a) State and explain the 2D sampling theorem. Explain how aliasing errors can be eliminated? (7 marks)

   b) Define the terms brightness, contrast, hue and saturation with respect to a digital image. Explain the terms False contouring and Machband effect. (K1 – CO1) (7 marks)

OR

2. a) Explain elements of visual perception simple image formation model in detail (K1 – CO1) (8 marks)

   b) Explain various color image models and its transformations (K1 - CO1) (6 marks)

Module 2

3. a) Explain the difference between DST and DCT. (K2 - CO1) (4 marks)

   b) Compute the 2D DFT of the 4x4 gray scale image given below. (K3-CO1) (10 marks)

$$f(x,y)=\begin{bmatrix}1 & 1 & 1 & 1\\ 1 & 1 & 1 & 1\\ 1 & 1 & 1 & 1\\ 1 & 1 & 1 & 1\end{bmatrix}.$$

OR

4. a) Construct a Harr transform matrix for N=4. (4 marks) (K3-CO1)

   b) Compute the 8-point DCT for following date X={2,4,6,8,10,6,4,2}. (10 marks)

Module 3

5. a) List histogram image enhancement techniques? Explain each one in detail. (10 marks) K2-CO2

   b) Write a note on color image enhancement. (K2-CO2) (4 marks)

OR

6. a) Describe the following in detail (i) Histogram equalization (ii) LPF and HPF in image enhancement (iii) high boost filters (10 marks)

Module 4

7. a) Assume 4x4 image and filter the image using median filter of 3x3 neighbourhood. Use replicate padding. (K3—CO1) (8 marks)

   b) Explain the digital image restoration. (K1—CO1) (6 marks)

OR

8. a) Explain inverse filtering with necessary equations. (K1-CO1) (6 marks)

   b) Differentiate various noise models. (K2-CO1) (8 marks)

Module 5

9. a) Explain the active contour algorithm for image segmentation any four geometric transformations on an image. (K2-CO3) (7 marks)

   c) Assume 4x4 image and filter the image using median filter of 3x3 neighbourhoods. Use replicate padding (K3—CO1) (7 marks)

OR

10. a) Explain global, adaptive and histogram based thresholding in detail. (7 marks)
    c) Explain Hough transform in detail (7 marks)